Advancements in Real-Time IR/EO Scene Generation Utilizing the Silicon Graphics® Onyx2™

Onda D. Simmons[a], Stephen E. Jacobs[a], Robert J. Makar[a], Frank J. Stanley[a], Tom W. Joyner[b], Keem B. Thiem[c]

[a]Comptek Amherst Systems, Inc., 30 Wilson Rd., Buffalo, NY 14221
[b]NAWC/AD, Comptek PRB Associates, Hollywood, MD
[c]Air Force Flight Test Center, Edwards AFB

ABSTRACT

This paper describes advances in the development of IR/EO scene generation to support the Infrared Sensor Stimulator system (IRSS) which will be used for installed system testing of avionics electronic combat systems. The IRSS will provide a high frame rate, real-time, reactive, hardware-in-the-loop test capability for the stimulation of current and future infrared and ultraviolet based sensor systems.

Scene generation in the IRSS is provided by an enhanced version of the Real-time IR/EO Scene Simulator (RISS) which was previously developed by Comptek Amherst Systems. RISS utilizes the symmetric multiprocessing environment of the Silicon Graphics® Onyx2™ to support the generation of IR/EO scenes in real-time. It is a generic scene generation system which can be programmed to accurately stimulate a wide variety of sensors. Significant advances have been made in IRSS capabilities in the past year. This paper will discuss the addition of new simulation techniques that have been added to the system to better support the high resolution, geospecific testing requirements of a new generation of imaging sensors. IRSS now better supports the use of high resolution databases which contain material maps at photo realistic precision. Other developments which will be discussed include extensive improvements to the database and scenario development tools, advances in the support for multiple synchronized scene generation channels, and new support for sea and ship models.

Keywords: Hardware-in-the-Loop, Simulation, Infrared, Scene Generator, Silicon Graphics®

1. INTRODUCTION

The Office of the Secretary of Defense (OSD), Central Test and Evaluation Investment Program (CTEIP) is tasked to provide a coordinated process for making joint investments in defense test & evaluation (T&E) to offset the challenges presented by declining investments in test assets and increasing test requirements. Under CTEIP sponsorship, the Navy and Air Force are jointly developing three Joint Installed System Test Facility (JISTF) enhancements that are based on dynamic virtual reality simulation technology. The three enhancements are the Infrared Sensor Stimulator (IRSS), Generic Radar Target Generator (GRTG), and Joint Communications Simulator (JCS). The IRSS system will be used to stimulate installed IR/EO sensors undergoing integrated developmental and operational testing.

The Infrared Sensor Stimulator (IRSS) is an integrated hardware/software system based on Comptek Amherst Systems' Real-time IR/EO Scene Simulator (RISS). The RISS has been specifically designed to support the design, development, integration, and testing of IR/EO sensor systems. The IRSS will be able to support both performance characterization and integrated sensor testing. The IRSS generates radiometrically correct scenes in real-time for reactive hardware-in-the-loop testing of a wide variety of infrared sensor systems. The generated scenes provide a realistic portrayal of the infrared scene radiance as viewed by the unit under test (UUT) in operational scenarios. Use of commercial-off-the-shelf (COTS) Silicon Graphics (SGI) fast symmetric multiprocessing hardware has minimized cost and development time. During real-time scene simulation, the multiprocessors are used to update polygon vertex locations and compute radiometrically correct floating-point radiance values for each waveband. Scene radiance is calculated on a frame by frame basis accounting for the relevant contributions from the sky, sun, targets, terrain, and atmosphere as a function of the engagement geometry by using existing validated high-fidelity IR models.

The frame output of the IRSS is configurable to match the characteristics of the sensor system under test. Sensor parameters such as frame size, frame rate, spectral band, number of bands, pixel resolution, and field of view are user configurable. The digital output of the IRSS can be formatted for direct injection into receiver/processor hardware or to drive an infrared projection system.

The baseline IRSS system includes the hardware and software components to provide a complete IR/EO simulation and test environment. Functionally, the IRSS system includes software to support off-line modeling, database development, scenario generation, and simulation control. Real-time functions include scene generation and sensor stimulation. The IRSS system supports both open-loop and closed-loop simulation. Open-loop simulation allows the user to execute predefined, time-sequenced scenarios ensuring total control over scenario events. Closed-loop simulation is supported through an external interface where the unit under test (UUT) and target position data can be generated by external simulations and provided to the IRSS system for reactive engagements.

In an integrated configuration, the IRSS can be coupled with RF simulators and facility level composite mission simulators for correlated, synchronized multi-spectral testing. The IRSS supports the stimulation of single or multiple aperture sensor systems. The system is modular in design to support incremental expansion of both function and performance to meet current and future test requirements.

The IRSS system architecture is illustrated in Figure 1. The IRSS program, including an overview of its major subsystems, was briefed at AeroSense 1999. This paper presents advancements in IRSS scene generation enhancements, including the use of high resolution databases which contain material maps at photo realistic precision. Other developments which will be discussed include extensive improvements to the scenario development tools, advancements in the support for multiple synchronized scene generation channels, and new support for sea and ship models.

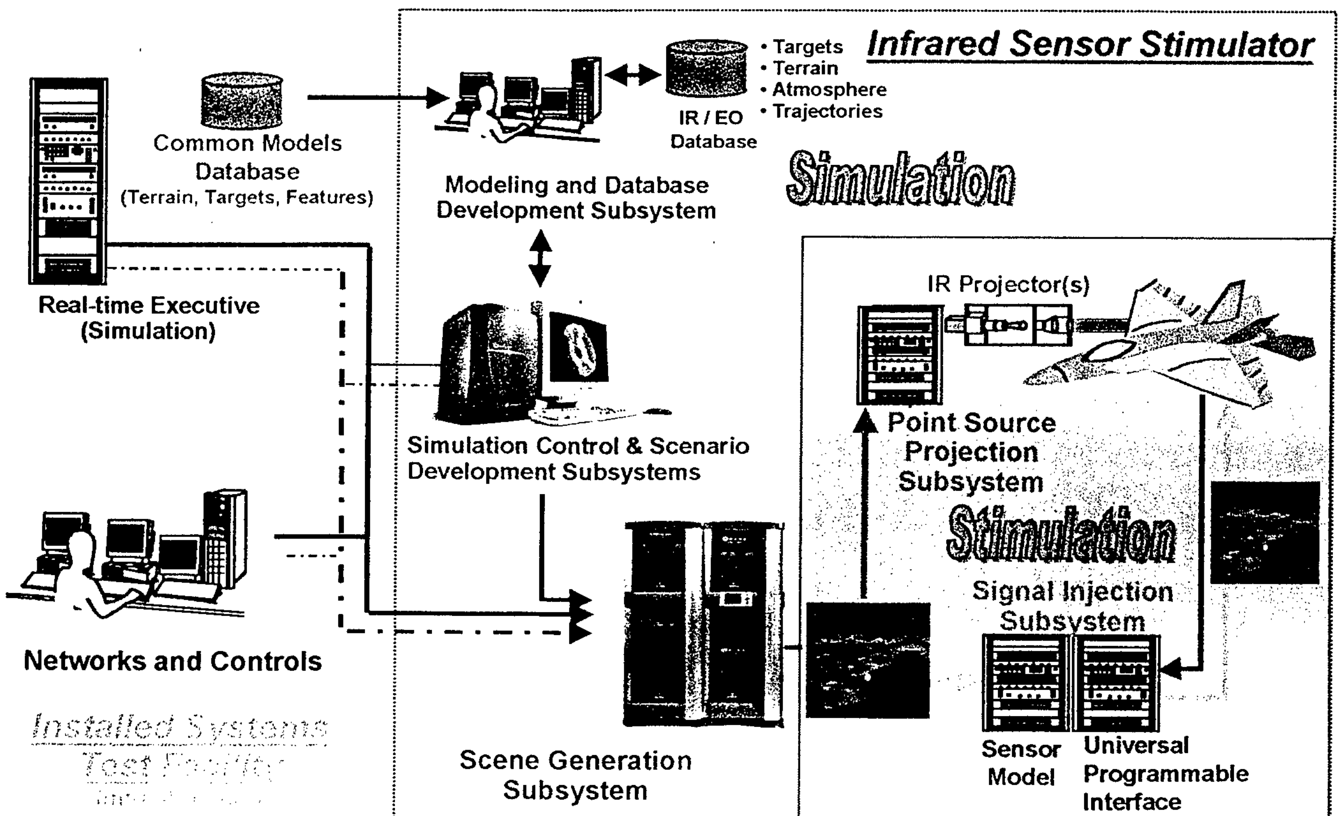

Figure 1-1. IRSS System Architecture

2. ADVANCES IN TERRAIN SIMULATION

Radiometrically-correct real-time simulation of realistic terrain requires three essential elements. First, a high-resolution description of the physical properties of the terrain, both in terms of material composition and topography is needed. Second, high-fidelity models for the sensor and its physical environment must be employed. Finally, sophisticated algorithms must be used to combine the models and the terrain description into rendered scenes accurately and in real-time. IRSS effectively combines all three of these elements, providing a new level of realism to real-time sensor simulation. Since the terrain description is based only on its physical properties, it can be used to simulate the terrain regardless of the waveband(s) of the sensor being modeled, and correlating images with different wavebands is easily accomplished. The description can also be used in conjunction with a thermal model to include realistic seasonal and diurnal effects. Radiometric accuracy is achieved through the use of accepted phenomenological models and advanced algorithms. Geospecific texturing results when correlated satellite imagery and digital elevation models for a specific region are used to create the terrain description.

2.1 Terrain Description and the Models

Terrain databases are fully attributed, faceted surface descriptions derived from Digital Terrain Elevation Data (DTED) augmented with cultural details such as roads, bridges, and buildings. The DTED data is used to create polygonal wire-frames representing terrain contour or shape. Terrain attributions include material properties, textures, and temperature specifications. Background detail (e.g., texture) at the sensor pixel level is represented by texture maps overlaid on larger terrain polygons.

Increased availability of satellite imagery, and the development of sophisticated image analysis techniques, has made the high-resolution description of terrain material composition a practical reality. Classification techniques are employed to determine the material or material mix of the terrain from satellite images on a texel-by-texel basis. A material code number is assigned to each texel, and all the codes for a specific patch of terrain are assembled into a "material map", or, in the case of a material *mixture* being assigned to a texel, a "material mix map". The material codes are cross-referenced to a table that gives all the pertinent properties of each material. The use of material mixtures has an advantage over using a single material per texel in that it enhances the level of detail in the terrain image and smoothes the transitions between regions of differing material types.

Two types of topographic descriptions of the terrain are required. First, the effective utilization of computer graphics technology drives the need for the terrain to be described in terms of a triangular irregular network, or TIN. A TIN representation is readily obtained from government-distributed digital elevation data by using commercially available Delaunay algorithms.

The second type of topographic description required is at a higher, texel-level, resolution. This is necessary due to the sensitivity of the texel's radiance to its normal vector and its elevation. While the texel's source radiance is modeled as being independent of its orientation (i.e., Lambertian), its normal vector and elevation can have a significant impact on the source radiance, by effecting the texel temperature. The normal vector also determines how much sunshine, skyshine, and earthshine the texel reflects. The texel-level topographic data can be readily derived from digital elevation data using standard interpolation and gradient estimation techniques when texel level elevation data is not available.

To efficiently store texel-level terrain data, a new file format, called MMT (for material mix and topography), was developed for IRSS. This format stores the material mix data for each texel, as well as the texel-level topographic data, into a single file, which is then correlated to a TIN in the same manner as a normal texture. The topographic data takes the form of elevation, 2-D gradient, and cross-derivative samples at equally spaced posts. Elevation and normal vector data is then easily calculated at intermediate texel locations using bicubic interpolation. This bicubic representation itself reduces the storage requirement from 16 bytes/texel to less than about 1 byte/texel. The post spacing is selected to approximate the resolution of the source data, which can result in further efficiency without adding any additional processing burden.

The primary models employed by IRSS in terrain simulation are for sensor spectral response, atmospheric effects, and for the determination of terrain temperatures. The user models the sensor spectral response during the scenario development process by simply entering sensor response values, and corresponding wavelengths, into a table. Atmospheric effects are modeled using the industry-standard atmosphere model, MODTRAN. The IRSS architecture is designed to facilitate the use of different thermal models, but currently uses only TERTEM.

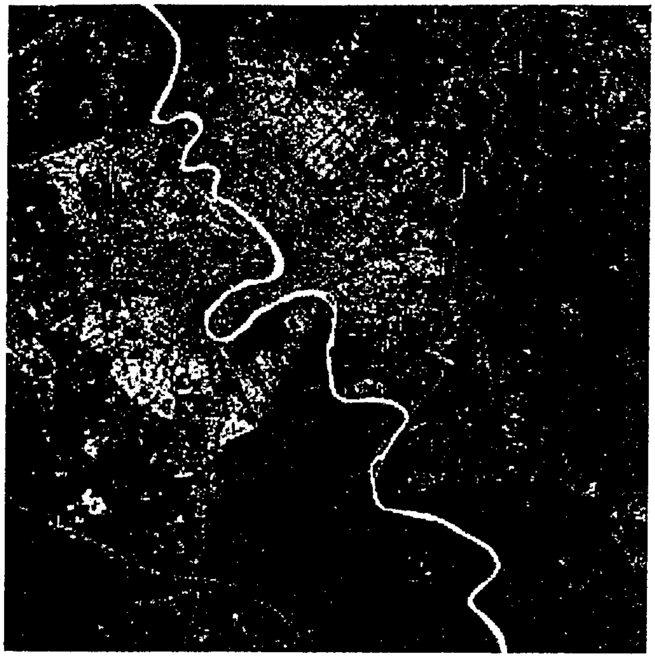

Figure 2-1. Material map,160 meter resolution.

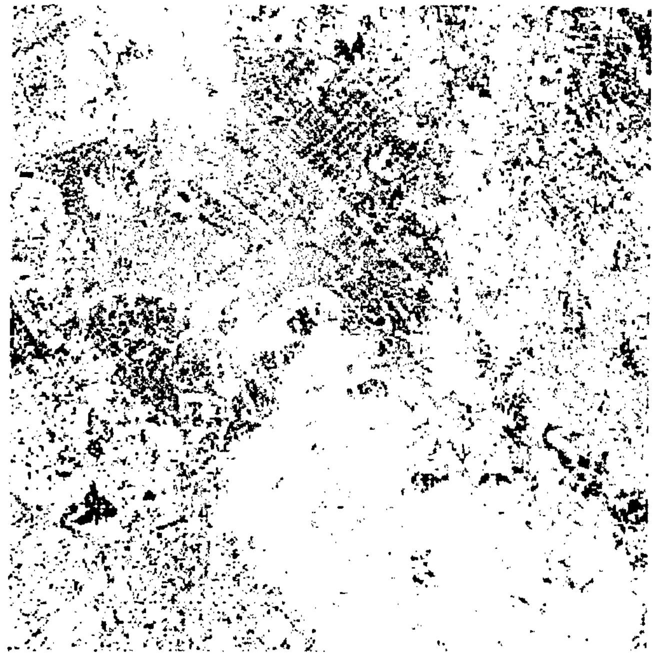

Figure 2-2. Radiance map,160 meter resolution.

2.2 Terrain Rendering Algorithms

For maximum efficiency, the terrain rendering algorithms have been designed to perform as much calculation as possible before run time, while still preserving accuracy. This non-real-time calculation consists of the generation of lookup tables and texture. The lookup tables are used to calculate attributes for terrain facet vertices that vary widely with the position of the sensor relative to points on the terrain. These attributes account for the effects of atmospheric attenuation and path radiance. The texture is used to account for a number of first principles physical effects, including temperature variations, thermal radiation, and solar, skyshine and earthshine reflections. The generation of this texture, called an adjusted radiance map, is expedited by first generating and then using lookup tables.

The lookup tables and adjusted radiance map are pre-calculated, then utilized in the real-time simulation process. The attributes of terrain facets within the field-of-view are calculated on a vertex-by-vertex basis, and the results sent to a rendering engine along with the specially formulated texture. The IRSS has the capability to render scenes using either SGI graphics hardware, such as the InfiniteReality, or by using Comptek Amherst Systems' scene rendering subsystem (SRS), which is designed specifically for sensor applications. In either case, a unique rendering algorithm is employed to create the desired imagery with high accuracy.

To assess the accuracy of this new rendering technique, precise calculations of the apparent radiance of the terrain were compared to the results that would be obtained using the rendering technique, for a wide variety of sensor-to-terrain geometries and parameter variations. This analysis showed that the error introduced by the algorithms used were generally a fraction of a percent, but that in certain extreme cases can grow to approximately 1%.

3. ADVANCEMENTS IN SCENARIO DEVELOPMENT TOOLS

The IRSS program has put a great deal of emphasis on providing a complete test environment for future users. Consequently, tools for database development, building and editing scenarios, and configuring and controlling test assets have been an important part of the IRSS development effort. In contrast to special purpose test environments, the IRSS is equipped with standard graphical user interfaces for selecting test scenarios, initializing simulation hardware assets, configuring the optional external control utilities, executing tests, and collecting results. The intent is to make the capabilities of IRSS accessible to all ISTF users.

The test development process can be a costly, time-consuming aspect of installed systems testing, consequently, the IRSS development team has devoted considerable effort to designing and implementing efficient, user-friendly scenario development tools. Advancements in this area include a graphical scenario sequencer, interactive waypoint editing for integrated trajectory models, and multichannel configuration tools.

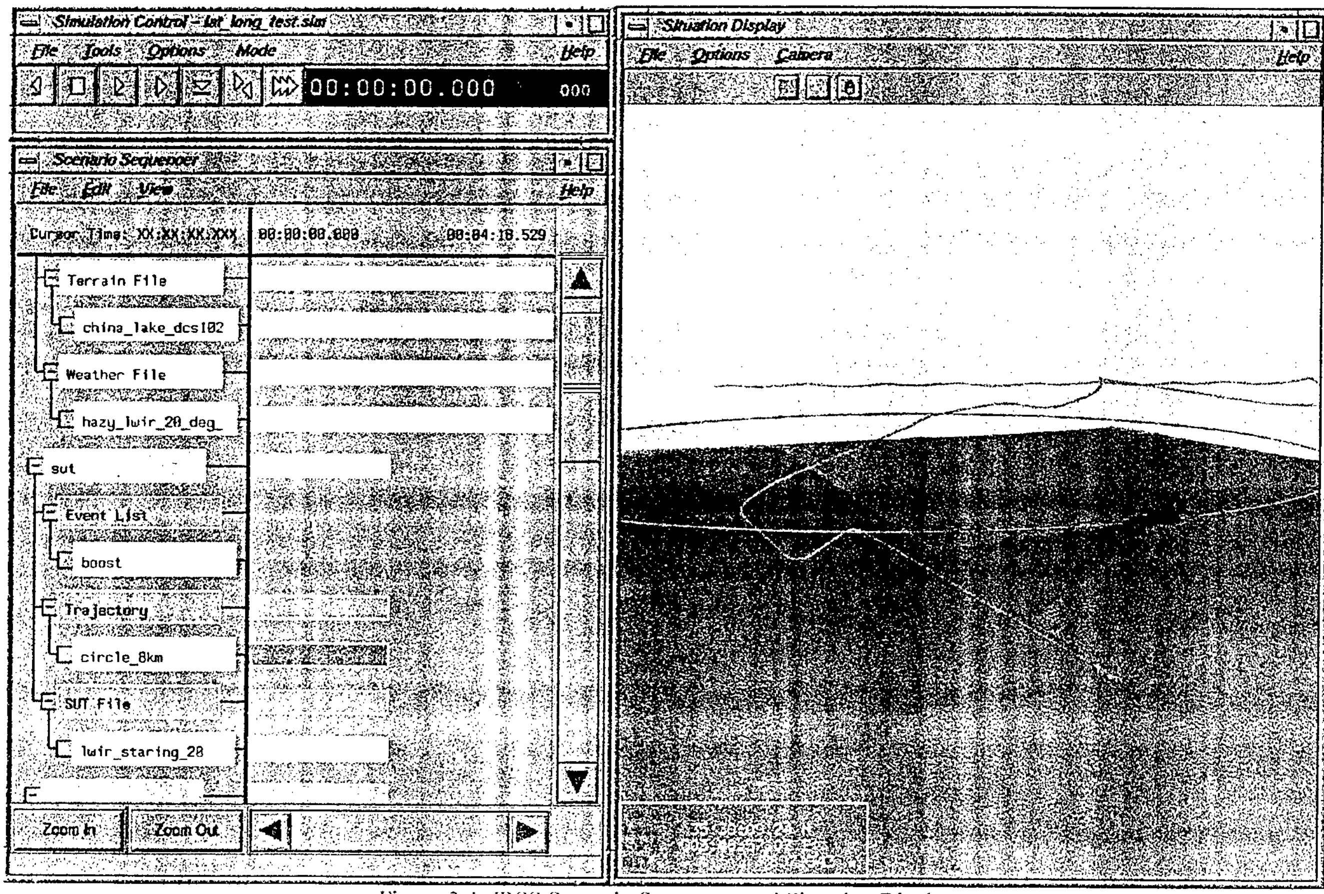

Figure 3-1. IRSS Scenario Sequencer and Situation Display

The scenario generation application developed for IRSS relies on two key features: the situation display and the scenario sequencer. The situation display is a Silicon Graphics Performer-based application. It provides a user-configurable view of the gaming area, and displays the positions of the system under test and other dynamic players, as well as a representation of player trajectories. The situation display is active during scenario development and scene generation, providing both a placement/preview function, as well as feedback to the user during test execution. Advancements to the situation display include integration of the trajectory models ESAMS, TRAP, and BLUEMAX. This integration allows the trajectory models to be launched during player creation, and supports point and click waypoint insertion. The scenario sequencer provides a graphical summary of terrain, objects, and other components of a scenario. It presents all scenario events on a timeline and allows events to be added, edited, and deleted using standard click and drag GUI features. In conjunction with the IRSS situation display, the sequencer provides a powerful tool for creating, editing, and previewing test scenarios.

Synchronized multichannel simulation has been completed and integrated into the IRSS. This capability will allow the IRSS to provide coordinated simulation and stimulation for missile warning systems utilizing multiple sensors for complete coverage, as well as integrated avionics systems that rely on inputs from different sensors to provide coordinated functionality. This is a key requirement for installed sensor testing, where verification of the interoperability of several, possibly multi-spectral sensors is often required to assess the overall performance of a system under test.

Multichannel simulation in the IRSS is achieved by executing the simulation control application on an SGI Octane workstation which is interfaced to one or more scene generation pipelines or channels. Each channel is initialized with the same scenario components (atmosphere, terrain, targets, etc.), and processes the same events, synchronized in time with other channels. However, each channel can be independently configured to perform scene generation tailored to a specific UUT, in terms of frame-by-frame field of view changes, waveband, frame rate, frame size, etc. The IRSS implementation allows multiple systems under test (SUT) and units under test (UUT) to be defined in a single scenario.

4. IRSS FUNCTIONAL EXTENSIONS

Extensibility has been an important consideration in the design and development of the IRSS. IRSS is an installed systems facility upgrade, not a dedicated program test asset. Future users of the IRSS will likely have requirements for databases, models, etc. that are not currently integrated with the system. Consequently, open database formats and model integration issues have been design drivers. An important development in the past year is an application programming interface called the Plug-in Interface (PII). The PII supports functional extensions to IRSS by allowing external applications to be associated with a modeled object (terrain, vehicle, etc.) during the scenario development process. The external application then can control the temperature, geometry, etc. of the object or part of the object during scene generation. For example, a high fidelity signature model such as PRISM can be executed at a 1 Hz rate and provide vehicle facet/vertex temperature updates to the IRSS scene generator running at sensor frame rates of 100 Hz or more.

The PII involved enhancements to the Modeling and Database Development, Scenario Development/Simulation Control, and Scene Generation subsystems illustrated in Figure 1. New fields were added to the IRSS OpenFlight extensions to allow up to three external applications to be associated with a terrain or an object stored in the IRSS database. The terrain and/or object(s) can then be incorporated into one or more test scenarios. External application usage can be toggled on or off by the user at execution time. At initialization time, the PII objects are loaded into shared memory and the external application and PII server task are spawned. While running real-time, the external application sends and/or receives messages to modify the object in shared memory from a growing set of commands including: Get scenario time, Get component, Get facet or vertex temperature, Get vertex coordinates, Set component, Set facet or vertex temperatures, and Set vertex coordinates. Figures 4-1 and 4-2 are examples of temperature and geometry modifications provided by external applications. Terrain paging examples have also been developed using the PII.

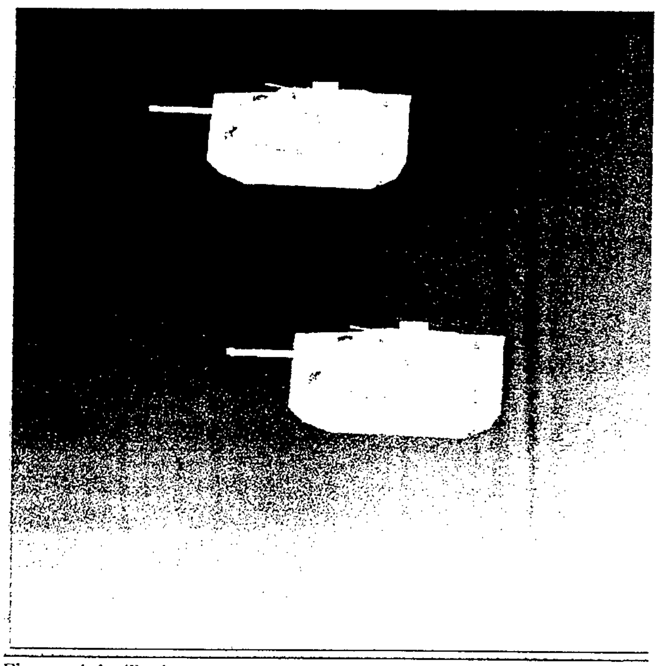

Figure 4-1. Tank component temperatures can be varied in real time.

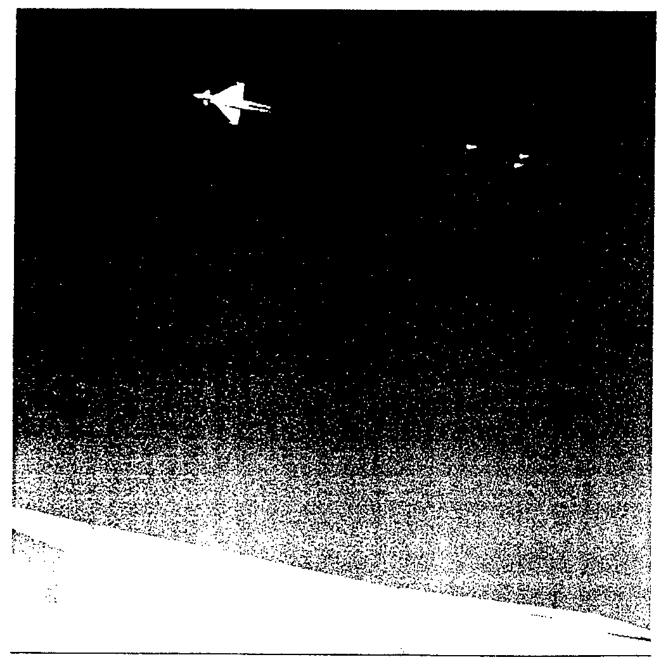

Figure 4-2. Flare shape, radiance, and transparency can be varied in real time.

5. EXTERNAL CONTROL INTERFACE

An external control capability has been developed and demonstrated for the IRSS system. This capability will allow an external simulator or simulation to control execution of an IRSS scenario, as well as the position and other characteristics of specific players (SUT and/or targets). Through this mechanism, IRSS will be synchronized with the other JISTF stimulators described in section 1 to provide coordinated multispectral simulation and stimulation of installed sensor systems. As illustrated in figure 1-1, a real-time simulation executive will provide general control and position information.

Dynamic scenario players can be designated as externally controlled players during scenario generation. During real-time execution, the position of these players will be determined via commands received over the external control interface. Position information which can be specified through external control includes Target and SUT position information and its derivatives. The position information can be provided in either WGS-84 ECEF or flat earth coordinates and includes the position information, Euler angles (Roll, Pitch, Yaw), Euler rates (Roll rate, Pitch Rate, Yaw Rate), among others.

Position information for up to 2 SUTs, 3 UUTs, and 20 active targets are supported. To control the IRSS system and provide supplemental data, messages are passed through the external control interface. General control messages that are currently supported include: *Start IRSS*, *Stop IRSS*. Once the IRSS system is initialized, a *Start IRSS* message can be sent through the external control interface to start the simulation. This command can specify a particular IRIG or time-of-day. Similarly, a *Stop IRSS* message can be sent through external control to stop the simulation.

Supplemental message-based commands allow an external process to control the players and UUT within the simulation. Currently, the following supplemental commands are supported: *Activate Platform*, *Deactivate Platform*, *Platform Target Mode Change*, *UUT Orientation Changes*, and *UUT Field of View (FOV) Changes*. Platform activation/deactivation allows players to become visible and invisible during a simulation. This allows events such as missile launches to be defined in a scenario. Platform Target Mode changes allow a platform to change its IR properties during a simulation, e. g., a transition from military power to after burner for an aircraft. UUT Orientation and FOV changes allow the external application to change sensor properties in real time, for example to transition a FLIR from a wide FOV search mode to a narrow FOV track mode.

External control is implemented using internal shared memory which a separate configuration application process must attach to and communicate through. Information available in the shared memory is then read by the IRSS task and processed. This design can support a wide variety of external control interfaces such as DIS, HLA, and the composite mission model SWEG (Synthetic Warfare Environment Generator), as well as custom hardware-in-the-loop interfaces. The configuration application isolates the IRSS from the hardware and protocols used for external control. Configuration applications can be easily developed for a variety of external control implementations. The application used to implement a SWEG interface for use in the ACETEF at Paxtuxent River uses SCRAMNet with IRIG time synchronization. However, configuration applications can also be written to use Internet, Gigabit LAN, ATM, or reflective memory interfaces for communication with the controlling system.

6. MARITIME MODELING

A US Navy requirement for IRSS to test targeting and navigational FLIRs in maritime environments led to the introduction of a Maritime Combat Environment (MACE) modeling capability into IRSS. This involved the integration of a maritime thermal model derived from the US Navy's IRENE model.

6.1 Requirements for Maritime Modeling

The ground vehicle model PRISM and the aircraft model SPIRITS had already been selected for integration with IRSS. These two models were chosen because of their widespread acceptance in the IR modeling community. While both of these models excel in their respective areas of modeling, they are less suitable for MACE. Our analysis of the requirements for ship and sea surface modeling indicated several unique features when compared to aircraft and ground vehicle modeling.

First, the signature modeling of a surface ship can be adequately described by a one dimensional thermal model. This is mainly attributed to the fact that most of the outside surface of a ship (hull and superstructure) are composed of relatively thin plates. Plate thickness is very small compared to the exposed surface area of these plates; therefore the plates can be treated thermally as one-dimensional, with almost all of the heat transfer being done perpendicular to the main faces of the plates (internal and external).

Second, the speed of a ship is comparable to most wind speeds encountered. This factor, coupled with the open-air environment of the ocean, make an accurate atmospheric convection calculation extremely important for a maritime signature model. Additionally, there can be significant temperature differences from region to region of a ship during normal operation. The ability to model these "hot regions" within the structure of a ship is critical to correctly modeling the thermal signature of the ship. Finally, the ocean background presents unique requirements for a thermal model. The background contributes a significant amount of radiance to a surface ship, and must be modeled as accurately as possible.

PRISM is a detailed three dimensional thermal signature model used for temperature/radiance calculations of ground-based vehicles. In this modeling realm, a three-dimensional conduction/convection model is necessary due to the thick nature of the plates making up the exterior of the vehicle. This feature is unnecessary for ship modeling. PRISM does not represent the background environment adequately for the maritime environment. It computes a general background radiance, which is insufficient when dealing with the significant effects of solar glint on the sea surface.

SPIRITS is a three dimensional signature model used for temperature/radiance calculations of aircraft flying through the atmosphere. Wind-driven thermal convection is not critical in this environment, consequently, the convection modeling capability of SPIRITS doesn't satisfy the IRSS MACE requirement. Also, the inclusion of internal heat sources (hot parts) in SPIRITS is not very straightforward.

6.2 Candidates for MACE

The investigation of existing maritime models led to two main candidates: NTCS/SHIPIR and IRENE. The first is a product of W.R. Davis Engineering, Ltd. of Ontario, Canada. This model not only calculates the thermal and radiometric properties of a ship in its environment, but it also is capable of simulating complete missile engagements between the ship and a variety of anti-ship missiles. The features important for a complete maritime model are included in this model, which made it an excellent candidate. In addition, it has been accepted as the standard NATO maritime model under RSG.5.

The second model considered, IRENE, is a model developed and maintained by the US Navy at its Naval Surface Warfare Center (NSWC) Carderock Division in Bethesda, Maryland. It also contains the features necessary in a signature model with applicability to the maritime environment It has been used by the Navy for more than fifteen years, and was recently upgraded to version 9.0 to support DD-21 development. A verification and validation assessment of version 9.0 reported "object" temperature accuracy within five percent or better.

Both models were excellent candidates, and either would have satisfied the MACE modeling goals. The decision was made to work with the IRENE model, based on integration ease and the fact that the time available for the work to be done was relatively short. Also, as IRENE is a US Navy model developed under a US Navy contract, greater control was available to influence the integration effort.

6.3 MACE/IRSS Integration

The integration effort consisted of two major tasks: creation of a stand-alone thermal model, and development of a method to export IRENE-generated sea surface radiance data in a format useable by IRSS. The actual integration scheme for MACE was conducted in three phases (see figure 6-1). The first phase was carried out at NSWC Carderock. It involved modifications to IRENE to support subsequent integration with IRSS. First, a new file format (.sur output file) was created to contain all of the geometric and radiometric properties of the paints and materials for a ship. This new format replaced several separate files and made the data needed by IRSS more accessible.

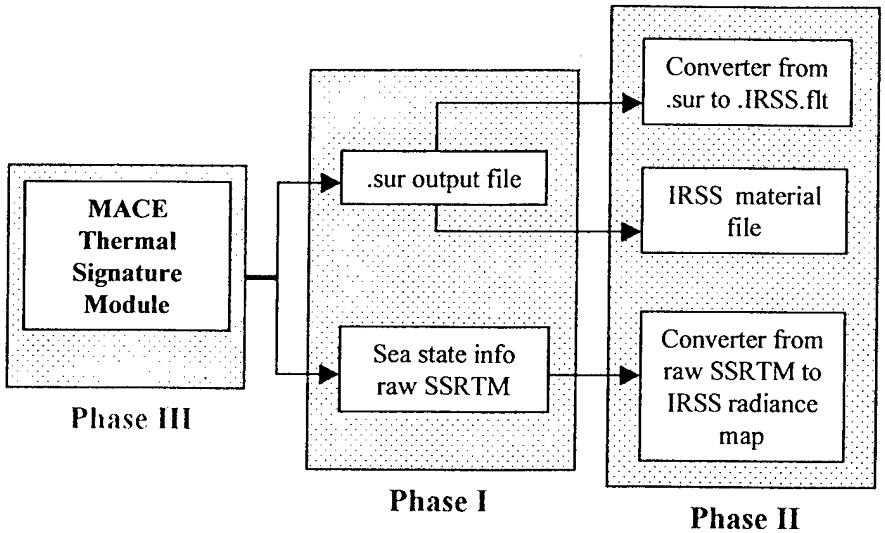

Figure 6-1. IRSS/MACE Integration Scheme.

A major portion of the MACE effort involved the development of a method for the creation and rendering of the ocean background. The background radiance is generated by a ray-tracing routine based on The Naval Research Laboratory's KELSEA model, which computes the source radiance of each square texel in a 512 x 512 grid, based on look angle, sun position and observer altitude. These texels can have a size of 1m or 5m on an edge, resulting in higher or lower resolution radiance map textures. In IRENE, the ocean surface data is an input to the target radiance calculations. For IRSS, the model was modified to output the sea surface radiance texture maps (SSRTMs) to be used in background rendering.

The second phase of the overall effort, carried out at Comptek Amherst Systems in Buffalo, NY, involved the development of a file converter. The converter extracts the necessary information from the .sur files (the modified IRENE output file) and creates an .IRSS.flt file in the extended OpenFlight format used in IRSS. An OpenFlight-compatible material file is also created for each material and/or paint used on the ship. This work was facilitated by the use of the Application Programming Interface (API) provided with Multigen-Paradigm's *Creator* program. The API allowed for fast and easy access to the OpenFlight file format, making the conversion a straightforward task.

Also part of Phase II was the conversion of the radiance data produced by the KELSEA-based sea surface model into a format usable by IRSS. The 16-bit, 256 color grayscale SSRTM data is converted into Silicon Graphics .bw texture format. This texture was then rendered as a radiance map, with atmospheric attenuation and path radiance calculated on a pixel-by-pixel basis. The third phase, also performed at NSWC, consisted of the complete rewriting of the IRENE thermal module, making it, in effect, a completely new thermal model for inclusion in IRSS.

6.4 MACE/IRSS Integration Results

Figures 6-2 through 6-5 illustrate some examples of images rendered by IRSS using MACE-generated ships and ocean surface textures. For all images, the sensor is a 256 x 256 staring LWIR array with a 10° x 10° field of view, and white is hot.

In general, the results are very satisfactory. The ships displayed in the images are actually two renderings of the same ship facing in nearly opposite directions. This was done to illustrate (within the limitations of graphical reproduction) the effect of sun position on thermal signature of the ship. The atmosphere used in the rendering is a clear atmosphere, therefore there is little attenuation of the targets and ocean surface texture as a function of distance from the sensor. Note that, aside from solar heating, the appearance of the ships in these figures is almost uniform. There was no attempt to create accurate hot part information for these particular examples, in order to avoid any security classification issues. Our tests indicate expected results when using realistic heated compartments in a ship model

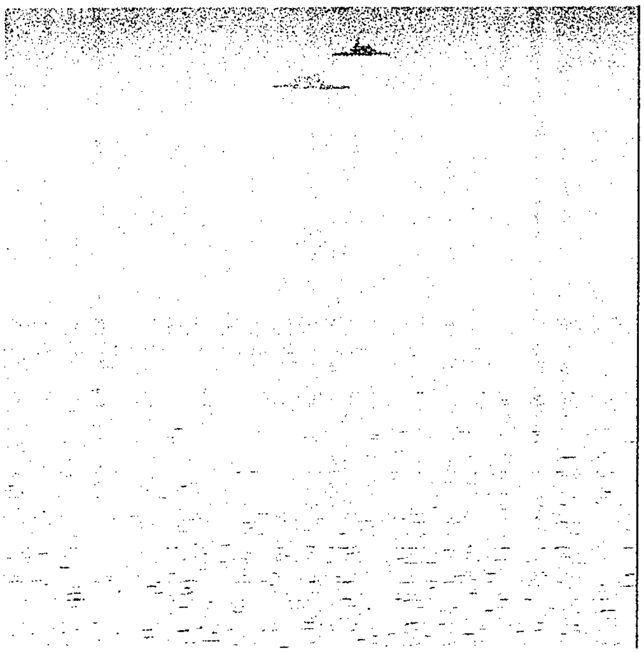

Figure 6-2. The ocean surface texture is 1m resolution and sea state 2. The sensor altitude is ~1225m with a look angle of −5°. Ranges to the two ships are 2650m and 3600m.

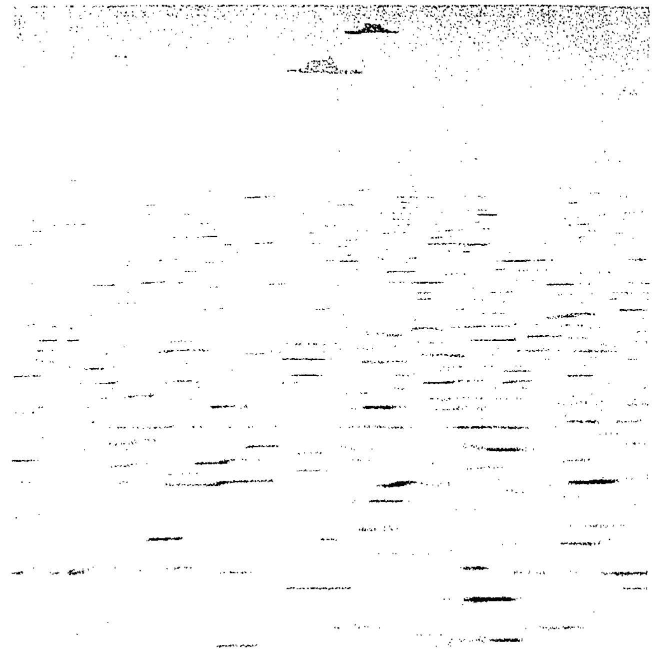

Figure 6-3. The ocean surface texture is 5m resolution and sea state 2. The sensor altitude is ~1225m with a look angle of −5°. Ranges to the two ships are 2650m and 3600m.

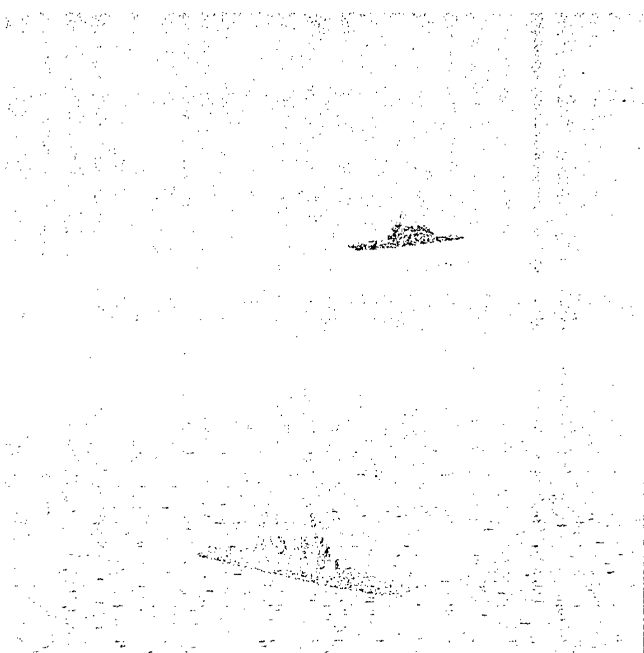

Figure 6-4. The ocean surface texture is 1m resolution and sea state 2. The sensor altitude is ~1400m with a look angle of −10°. Ranges to the two ships are 740m and 1560m.

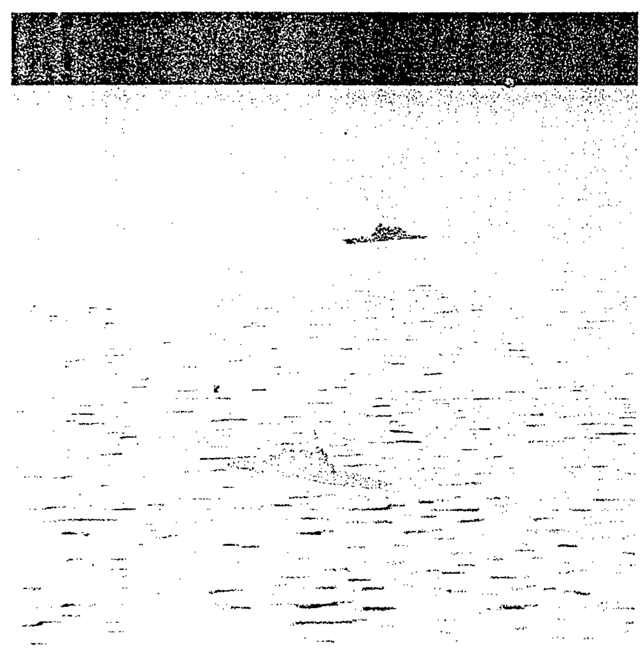

Figure 6-5. The ocean surface texture is 5m resolution and sea state 2. The sensor altitude is ~1365m with a look angle of −5°. Ranges to the two ships are 1200m and 2150m.

In addition to the technical results, another important outcome of this effort was demonstration that the integration of a stand alone model into IRSS can be very straightforward. The smooth integration of this model was due to two main factors: cooperation between the developers of IRENE and Comptek Amherst Systems, and the easily accessible OpenFlight format used by IRSS. The cooperation between the two parties allowed the work to be done in a minimal amount of time. Also, the expertise of the US Navy development team allowed for control of the way in which IRENE could be used for implementation.

6.5 Future MACE Modeling Efforts

The MACE team is currently seeking to identify sources of future funding for the continued development of the MACE capability. Some of the features earmarked for future work include the rendering of wakes, the creation of sea height maps for ocean backgrounds and the inclusion of plumes in ship models.

7. CONCLUSIONS

Comptek Amherst Systems has been under contract to develop the IRSS since February 1997. A total of five software builds have already been delivered. The complete IRSS system is scheduled for installation in September 2000. Current efforts are focused on hardware production, verification testing, and training.

8. REFERENCES

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This paper describes advances in the development of IR/EO scene generation to support the Infrared Sensor Stimulator system (IRSS) which will be used for installed system testing of avionics electronic combat systems. The IRSS will provide a high frame rate, real-time, reactive, hardware-in-the-loop test capability for the stimulation of current and future infrared and ultraviolet based sensor systems. Scene generation in the IRSS is provided by an enhanced version of the Real-time IR/EO Scene Simulator (RISS) which was previously developed by Comptek Amherst Systems. RISS utilizes the symmetric multiprocessing environment of the Silicon Graphics® Onyx2™to support the generation of IR/EO scenes in real-time. It is a generic scene generation system that can be programmed to accurately stimulate a wide variety of sensors. Significant advances have been made in IRSS capabilities in the past year. This paper will discuss the addition of new simulation techniques that have been added to the system to better support the high resolution, geospecific testing, and requirements of a new generation of imaging sensors. IRSS now better supports the use of high resolution data bases, which contain material maps at the photo realistic precision. Other developments that will be discussed include extensive improvements to the data base and scenario development tools, advances in the support for multiple synchronized scene generation channels, and new support for sea and ship models.

15. SUBJECT TERMS

Hardware-in-the-Loop, Simulation, Infrared, Scene Generator, Silicon Graphics®

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